Space Weather Technical Forecast

Issued on Wednesday, 12 January 2022 at 00:36 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storms day 4 (15th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was low with one C1 flare observed from the plage region close to the southeast limb at 11/0837UTC. There are four sunspot regions on the visible disc, Three of these are mature features, with the largest AR2924 Eho/Beta in the southwest, which is now showing some slight signs of decay. AR2925 and AR297 are both small remnant Hsx/alpha regions in the southern hemisphere. AR2926 Cro/Beta in the northwest quadrant has shown some small reemergence of spots but remains a very small and simple region. No Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speed as observed by DSCOVR at L1 has eased from slightly elevated levels of peak 420km/s to background at 350 km/s. The density of the wind was at or below average. Total interplanetary magnetic field (IMF) strength, Bt, was weak, peaking 6nT, with the Bz component also varying weakly between -4 and +5 nT. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet (Kp0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout. High energy electron flux (greater than 2MeV) was at background levels throughout. Electron fluence remained steady and well below the Active threshold (1e8 integrated pfu), with 1.29e6 integrated pfu recorded at 12/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Very Low. There is an increasing, but still slight chance, of this increasing to Moderate by day 4 (15th) as far-sided regions approach or move around the eastern limb.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Background solar winds are expected to persist until the arrival of the fast winds of coronal hole 44. This is most likely to occur on day 4 (15th). Mainly Quiet geomagnetic activity until this arrival, becoming Unsettled to Active with a chance of G1/Minor Storm intervals thereafter.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at background levels. The high energy electron flux (greater than 2MeV) is likely to increase through this period, perhaps reaching high levels on days 13 and 14 January. Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold, but with a rising trend later in the period.

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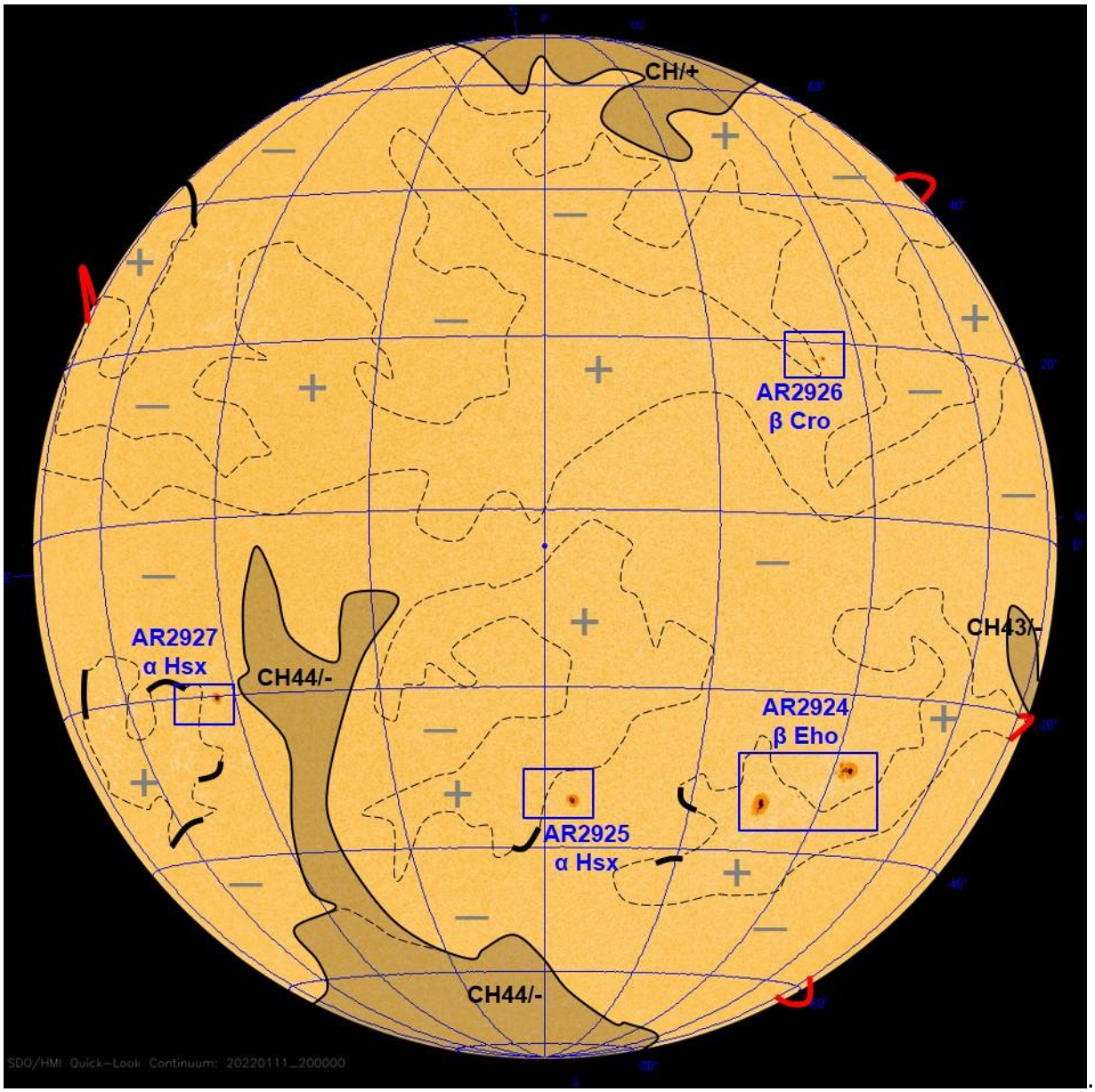
Figure 1. Solar Analysis Valid 11/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs.

Current background solar winds are expected to persist for much of the period. The arrival of the fast wind of coronal hole 44 is anticipated early on day 4 (15th), although there is some uncertainty. Enlil is currently providing poor guidance, suggesting arrival on the 13th, with persistence indicating an enhancement on 15th. Whilst the coronal hole has changed shape on this rotation, with a more western southern portion now closed, the northern portion is slightly more advanced on this occasion. With potential solar winds exceeding 600km/s, arrival is most likely on the 15th.

Geomagnetic activity is expected to be Quiet until the arrival of the fast wind, with a slight chance late day 3 (14th) but most likely early day 4 (15th). Activity is then expected to become Unsettled to Active, with a chance of G1/Minor Storm intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO aia-193 of previous rotation (left) and current rotation (right). Different CH structure clearly evident.

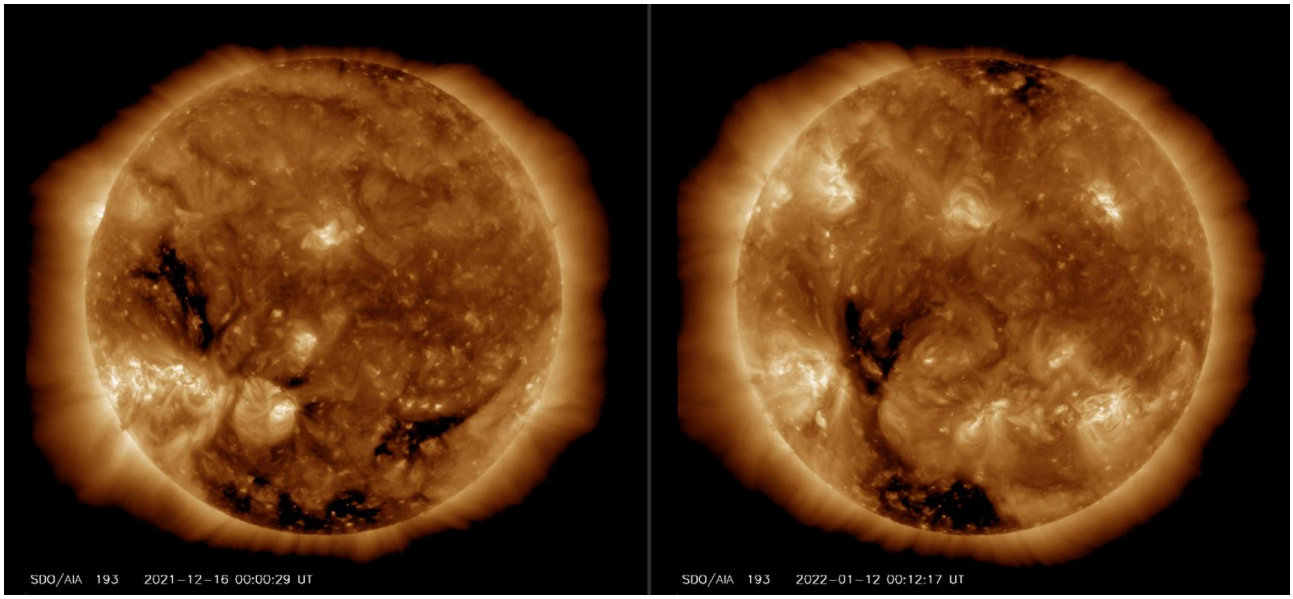

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Figure 3: Solar wind persistence Model Initial enhancement due to CH, no longer present on this rotation. Enhancement on 15th coincides with expected rise from current CH, but some notable uncertainty.

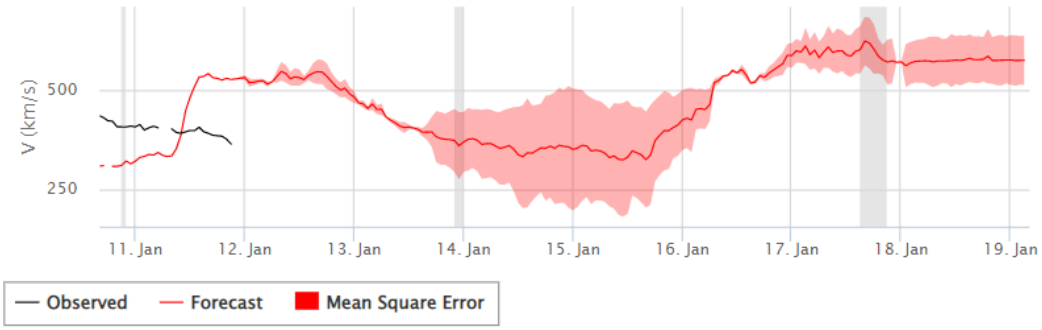


Figure 4: Enlil Model: Showing enhancement on the 13th, much earlier than persistence or current coronal position indicates.

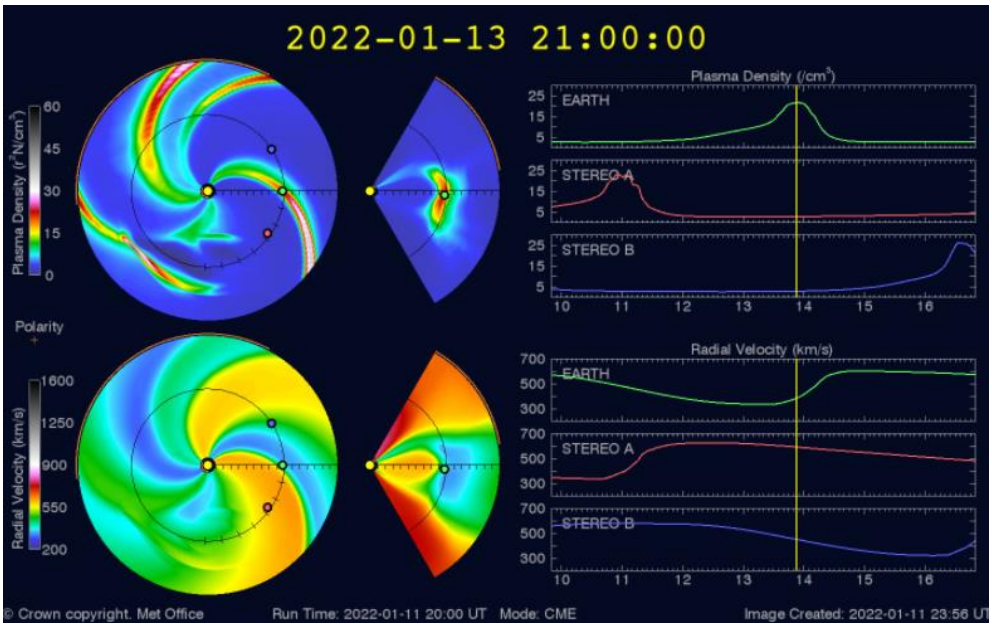
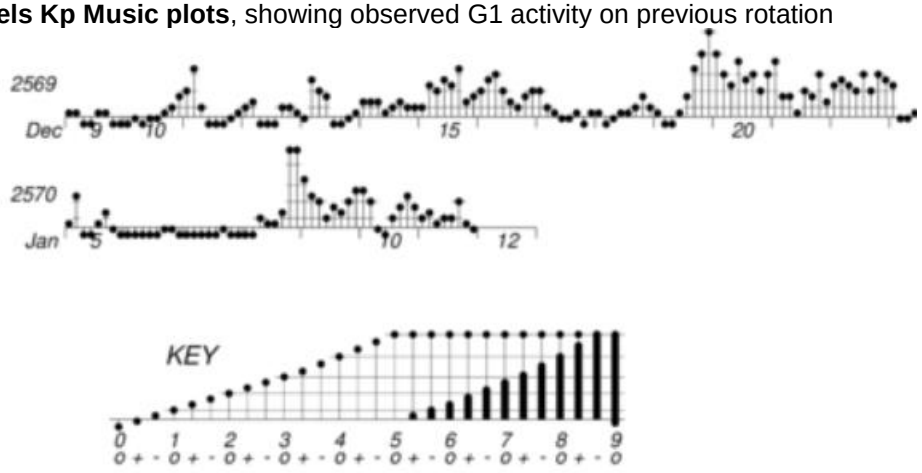


Figure 4: Bartels Kp Music plots, showing observed G1 activity on previous rotation



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Radio Blackouts - X-Ray Flares:

Solar activity is currently Low, with one C-flare in the last 24 hours, from an area of plage in the southeast quadrant. There are four sunspot containing active regions on the visible disc, however these are all magnetically simple and currently stable.

AR2924 Eho/beta is the largest feature, but has persisted as a dynamically inactive region as it traversed the southern hemisphere, and is now showing signs of gradual decay as it rotates towards the west limb. AR2925 and AR2927 are both small remnant Hsx/alpha spots in the southern hemisphere, and while AR2926 Cro/beta in the northwest quadrant has shown some slight dynamical changes, it remains a small and simple region. Solar activity is expected to be Very Low to Low at first, with only a slight (5%) chance of M-flares day 1 (12th)

There are two notable far-side regions, visible on far-side products, perhaps corresponding to ex-2915 and ex-2918 from the previous rotation. The former is due over the limb during day 3 (14th), whilst the former has a much stronger far-side signal and expected on the 16th, although any flaring from this region would potentially be observable by day 4 (15th). Consequently the M-flare risk is gradually increased to 20% by day 4.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	10	10	15
Very Active	R3 to R5 X Class	No	1	1	2	2

Figure 5: GOES-16/17 X-ray Flux

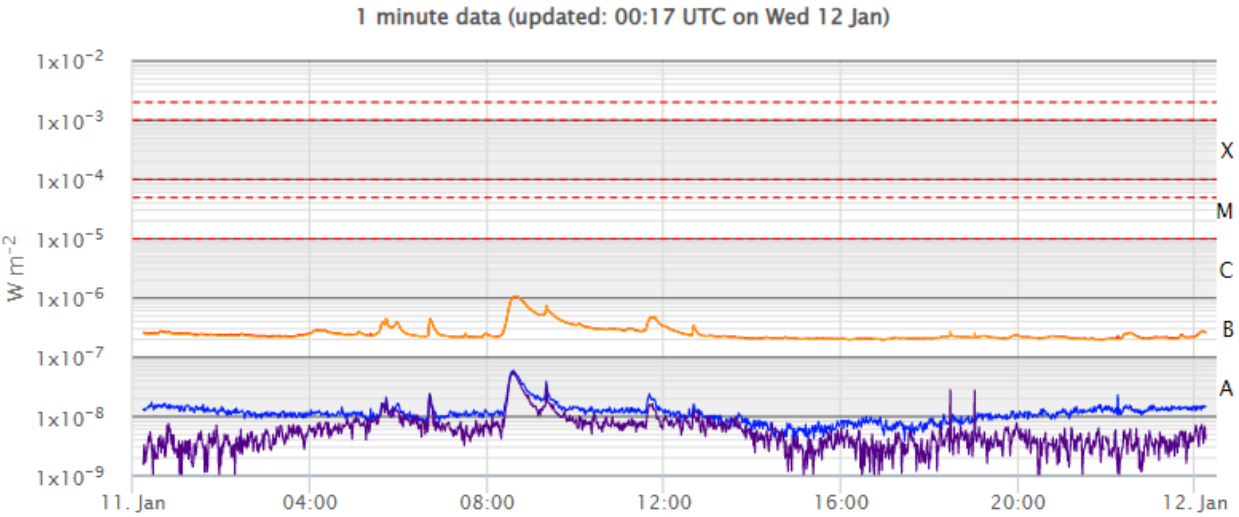

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Figure 6: Southern hemisphere sunspot regions (SDO Intensitygram top, and magnetogram bottom)

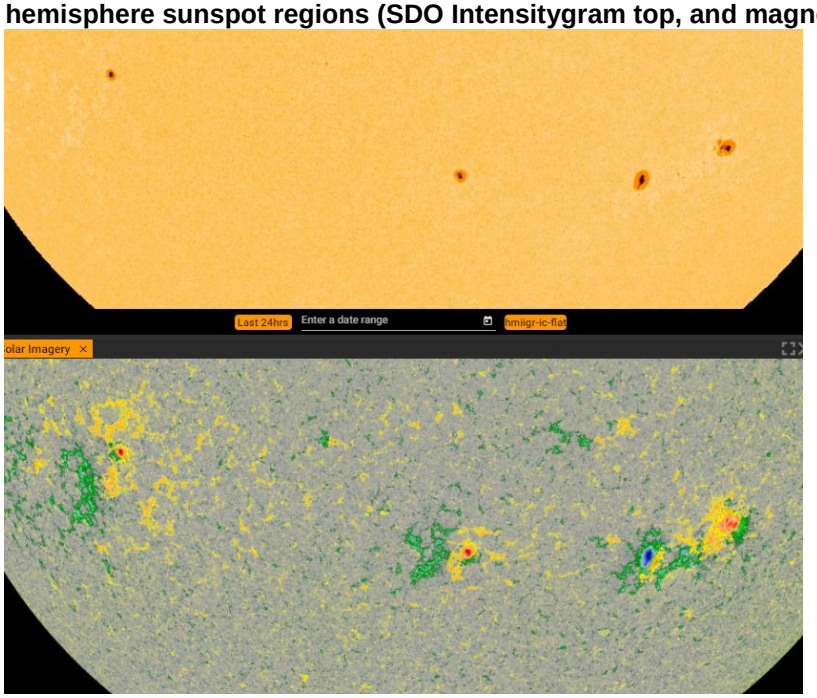
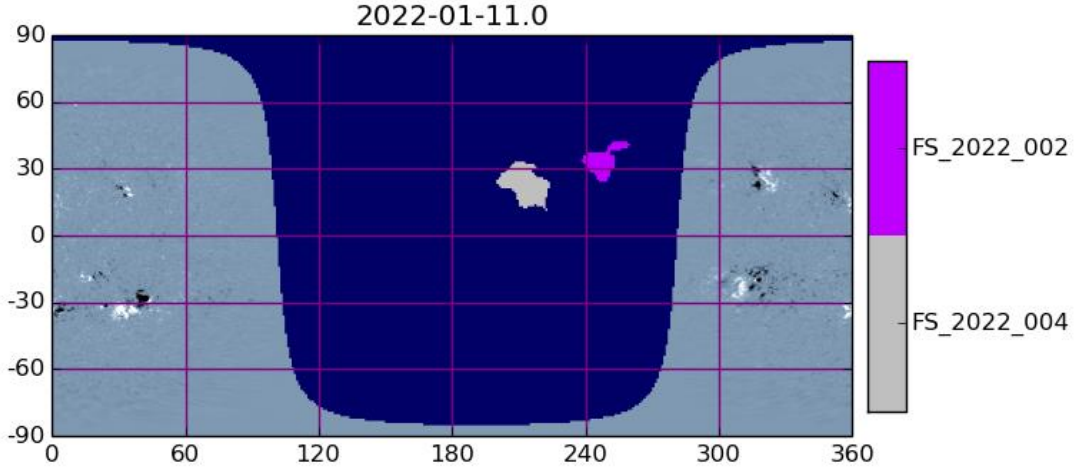


Figure 7: Far-side helioseismic signal showing potential regions returning



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist at this level in the absence of solar activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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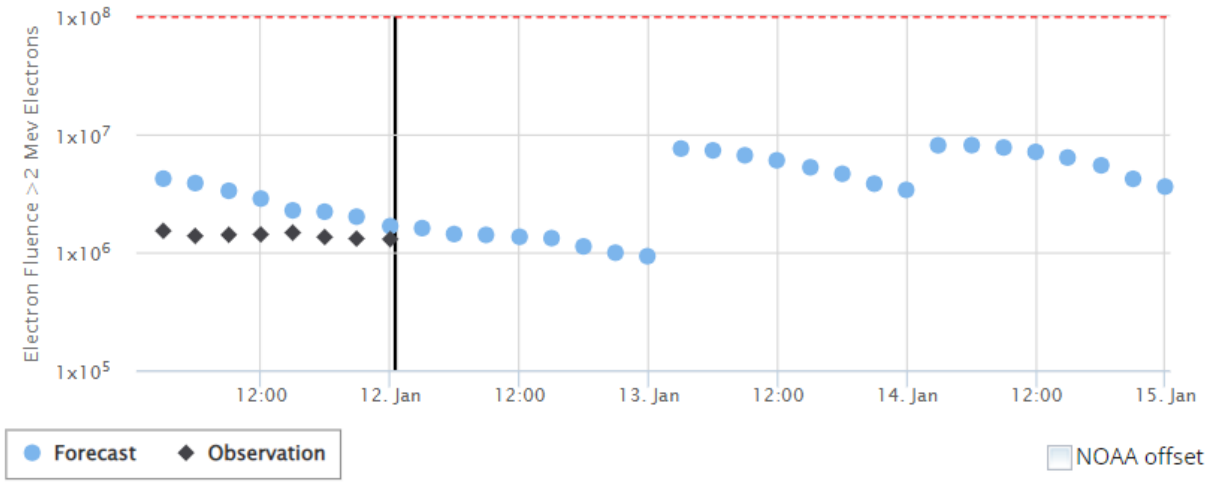
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been at background levels. Despite recent solar wind enhancement from the fast wind of CH43, there has been little sign of the electron population increasing as winds ease. There is still a chance of some moderate flux occurring through the period, however it looks likely that levels will remain below the alert level (1000 pfu).

The associated 24 hour electron fluence is below the Active threshold and expected to persist at this level, although a slight increasing trend is possible. This is supported by REFM, which is currently giving good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 8: GOES-16 >2MeV Electron Fluence with REFM



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